

Industrial Information Model

White Paper

1. Introduction

Currently STEP Application Protocols are built using information models from a pool of resources. It is felt that while most of the information models produced for STEP are of good quality there has been insufficient work on ensuring that they fit together properly and operate together to support the whole product life-cycle. An analysis of all the known STEP developments shows that the scope of STEP goes beyond the strictest definition of just Product Model Data, it also includes information about the means for designing the product, and the means for

- making,
- operating,
- supporting
- and disposing of the product.

For example, much of Logistics work is involved with information about the support organisation and its capabilities, e.g. available facilities, equipment, maintenance staff and skills. In addition to the above, STEP contains some basic concepts about Product Models, for instance it includes ways of representing and presenting information about the product.

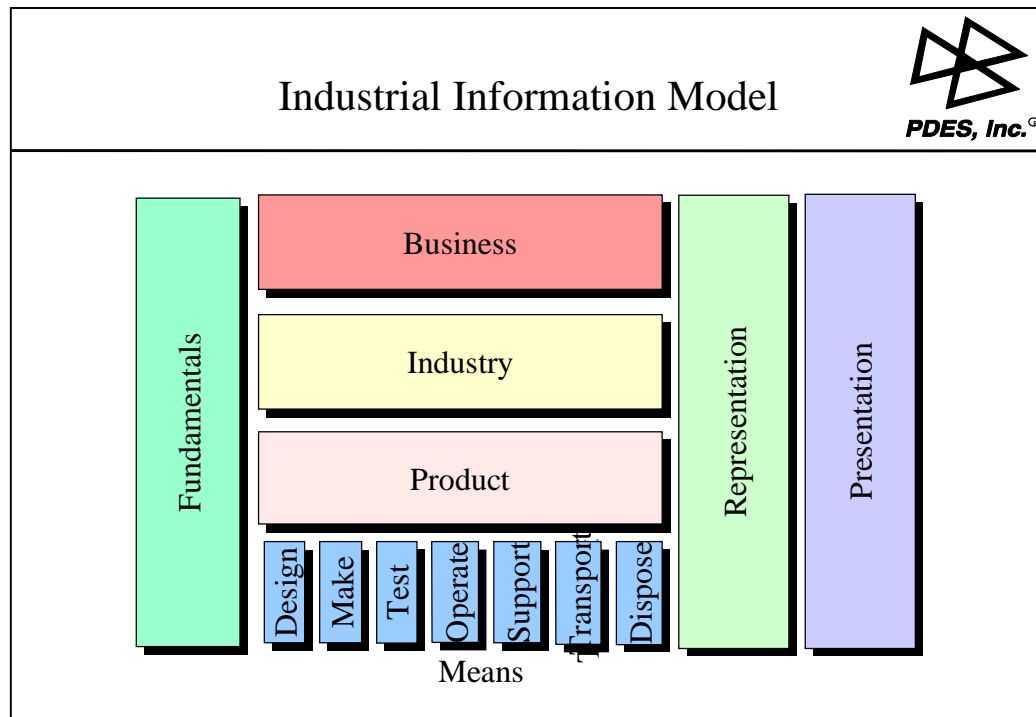
A new architecture for STEP is emerging based a modular use of resources. It is critical that these resources are verified to ensure the overall success of this effort. The purpose of this document is to describe a top down view of the concepts in STEP to complement and check the bottom up work on the current set of APs and modules.

This paper proposes an Industrial Information Model (IIM) against which all modules should be evaluated. The paper “Application Module Scoping Guidelines” defines a set of guidelines for the development of Application Modules. This paper includes an evaluation of new modules against this IIM to ensure that concepts being modelled are correctly understood. While checking modules against the IIM is seen as important it is recognised that there may be other models that would also be useful.

The next section defines the IIM while the rest of the document discusses the rationale for the model and the major relationships between the various categories.

2. Definition of IIM Categories

The following picture illustrates the set of categories proposed by the IIM. These categories are defined in this section.



The Product data is central - this is information that is true for ALL products

- Industry is information specific to particular industry sectors or product types.
- Business is the controlling information for the 'Create Product' process.
- Fundamentals are concepts that apply across most of the other groups and even to non-Product data.
- Means covers information about the processes that support the 'Create Product' process.
- Representation covers the various ways of representing product data.
- Presentation covers the ways of displaying or presenting information to a person

2.1. Fundamentals

These are fundamental concepts that:

- Are very general in nature
- Can be used by modules in any of the other categories
- Could in principle be used independently of STEP

2.2. Business

These are concepts concerned with the operation of and control exerted by business.

The links between modules in this category and the product information will be to record the control that business management had on aspects of the life-

cycle of the product. For example this category would include Project Management, Business Planning, and Purchasing.

It is probably not appropriate for STEP to define full information models for these categories but it should at least provide the appropriate linkage to these concepts.

2.3. Industry

This category covers product concepts that are specific to a particular industry or product type.

2.4. Product

This category covers concepts that are characteristic of all Products; it includes the identification and structure of both Product Definitions and Actual Products.

2.5. Means

The 'Create Product' process is operated by a number of organisations or factories.

These are concepts that are related to the means by which the product goes through its life-cycle. These categories contain the concepts involved with the creation, capabilities and operation of the life-cycle processes

2.5.1. Design

The Design 'organisation' activities related to designing the product

2.5.2. Make

The make organisation activities related to producing or manufacturing the actual item.

2.5.3. Test

The testing of an actual product against some predefined criteria or user requirements.

2.5.4. Operate

Resources related to the operation of the item.

2.5.5. Support

The support of the item throughout its operational life right up to disposal.

2.5.6. Transport

2.5.7. Dispose

The disposal of the product at the end of its life.

Note: The capabilities of the Make, Test, Operate, Support, Transport and Disposal Organisations are required by the 'Design Product' process to ensure the product is designed in a manner that can be manufactured.

2.6. Representation

Concepts that are used to represent attributes, properties or characteristics of a product but could be used for other purposes. This includes concepts such as

- Geometry that can represent the shape of a product
- Finite elements that can represent both the shape and behaviour of a product
- Bills of Materials or Product Structure Trees that can be used to represent the structure of a product

2.7. Presentation

Concepts necessary to create a presentation of product information through some form of sensory method. The sensory methods would include visual, tactile, auditory, olfactory.

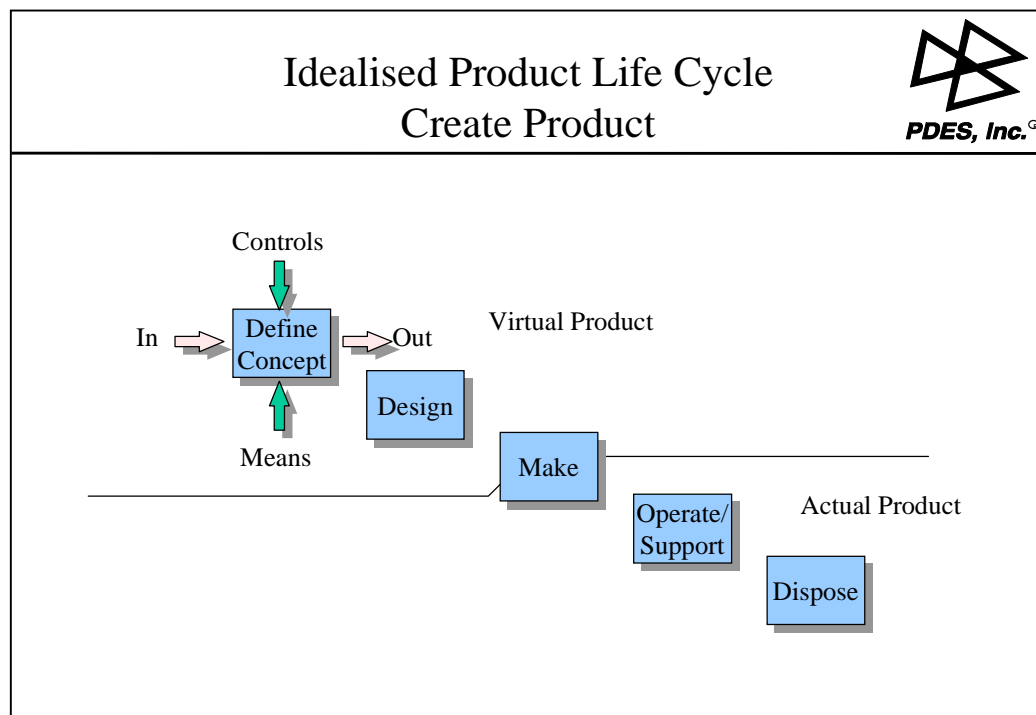
These concepts could be used to present information other than product information, but in the context of STEP they are only meaningful if associated with product information directly or via a representation of product information.

3. The Basic Business Process

To create the IIM we have gone back to the basic process that STEP is there to support. This process is the Product Life-Cycle or the 'Create Product' process.

The IDEF0 approach of modelling the process with its inputs, outputs, means and controls (or constraints) has been used. A *process* is defined as an activity that adds value to its *input* and creates an *output*. To perform the activity the process requires a set of *means* that allow it to function and the process is controlled (and constrained) in how and when it does the activity by the *controls*.

3.1. Idealised Product Life-Cycle Process



This diagram illustrates the typical processes for creating a product. To complete this picture the main inputs, outputs, means and controls must be identified.

Inputs and Outputs

The main input to that starts this process is the Customers Requirements.

These processes generate two main objects (the main inputs and outputs): -

1. The definition of the product - **virtual product**
2. **Actual products** that are supposed to conform to the product definition

Means

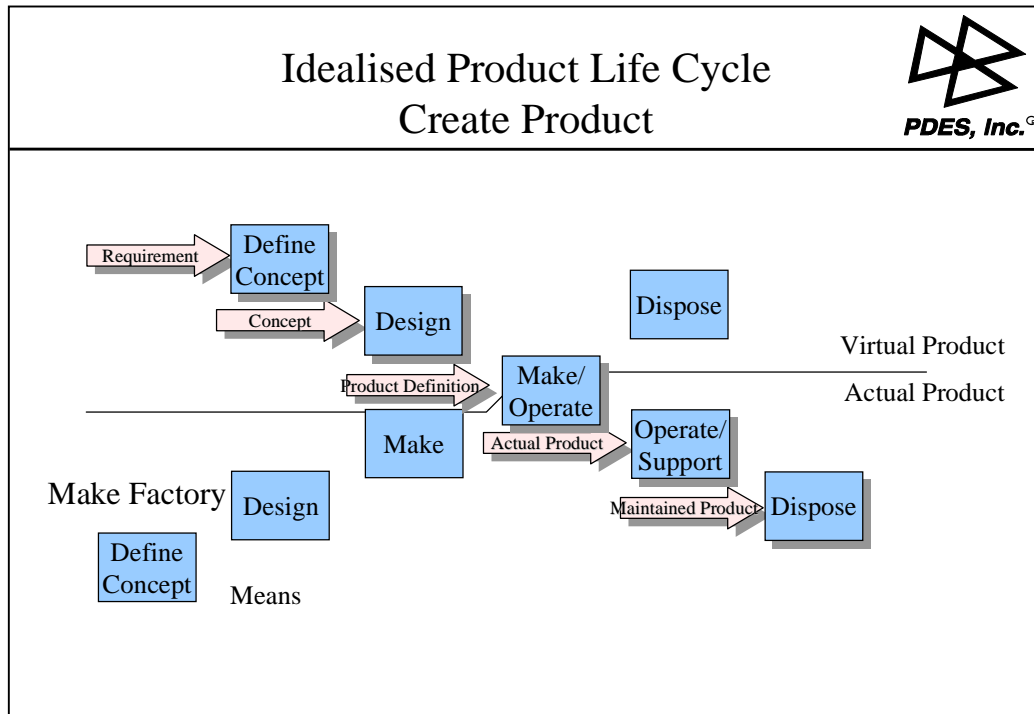
The means to the 'Create Product' processes are the

- Design Organisation,
- Make Factory
- Operate/Support Organisation
- Disposal Organisation

Control

Business management processes control the 'Create Product' processes.

3.2. Life-cycle of the 'Means'



This illustrates how the processes for creating the 'Means' relate to the 'Create Product' process.

The processes for creating the 'Make Factory' are shown as an example. This process follows the same stages as the 'Create Product' process, e.g.

- Define Concept,
- Design Factory,
- Make Factory,
- Operate/Support Factory,
- Dispose of Factory.

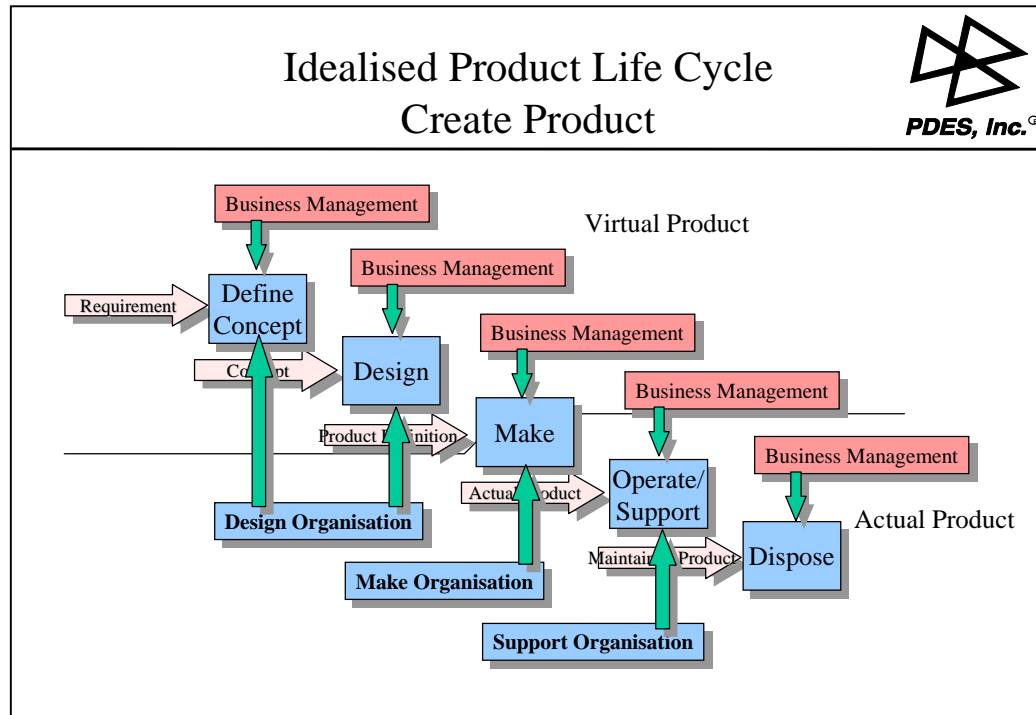
Note that the 'Operate/Support Factory' process is the same one as 'Make Product'.

This makes the life cycle of the product

Define Concept	which is	Operate Design Factory
Design	which is	Operate Design Factory
Make	which is	Operate Make Factory
Operate/Support	which is	Operate "Operate/Support" Factory
Dispose	which is	Operate Dispose Factory

The processes for creating the Design Organisation or Factory, the Support Factory etc follow the same structure.

3.3. Complete 'Create Product' Process



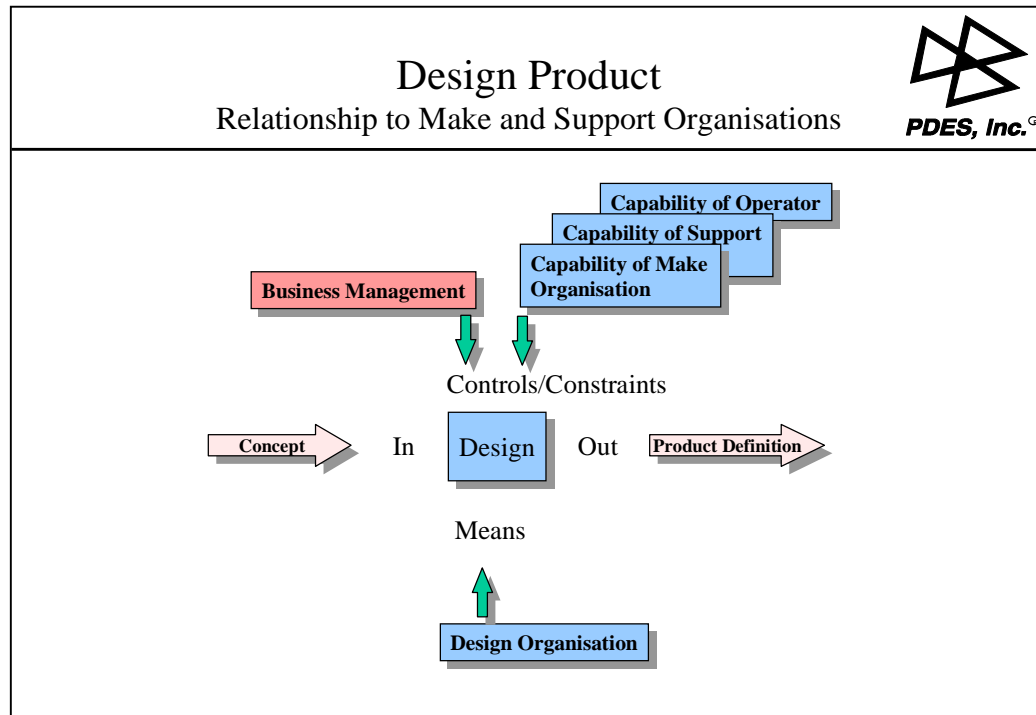
Building the ideas described so far into one diagram gives us a diagram to illustrate the typical process for creating a product.

It shows

- the requirement
- the virtual product (product definition)
- the actual product.
- the means for creating the actual and virtual product. e.g. the Design Organisation, Make Factory etc are 'Means' to the Product processes.
- the Business Management data controlling the process

Note that the Business Management data is NOT Product Data and hence STEP should probably not define information models for this area. However STEP must be capable of linking to this type of information.

3.4. The Design Process



This picture shows how the 'Design Product' process is constrained by the capabilities of the Make and Support organisations. For some Industries this would also include the 'Dispose of Product' organisation.

Note that the capabilities of the operator of the product may well be part of the customer's requirements.

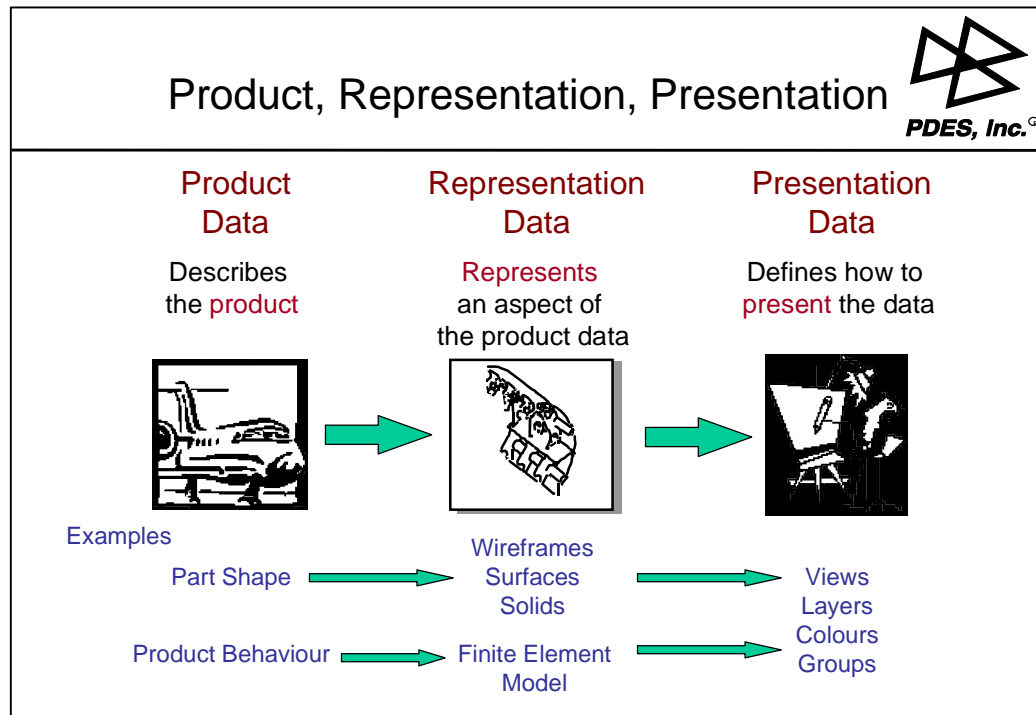
The capabilities of the organisation may be defined or implied by any of the life cycle stages:

- the concept of a new organisation
- the design of the new organisation
- the actual organisation

4. Major Relationships

This section describes some of the major relationships that exist between the categories of the IIM.

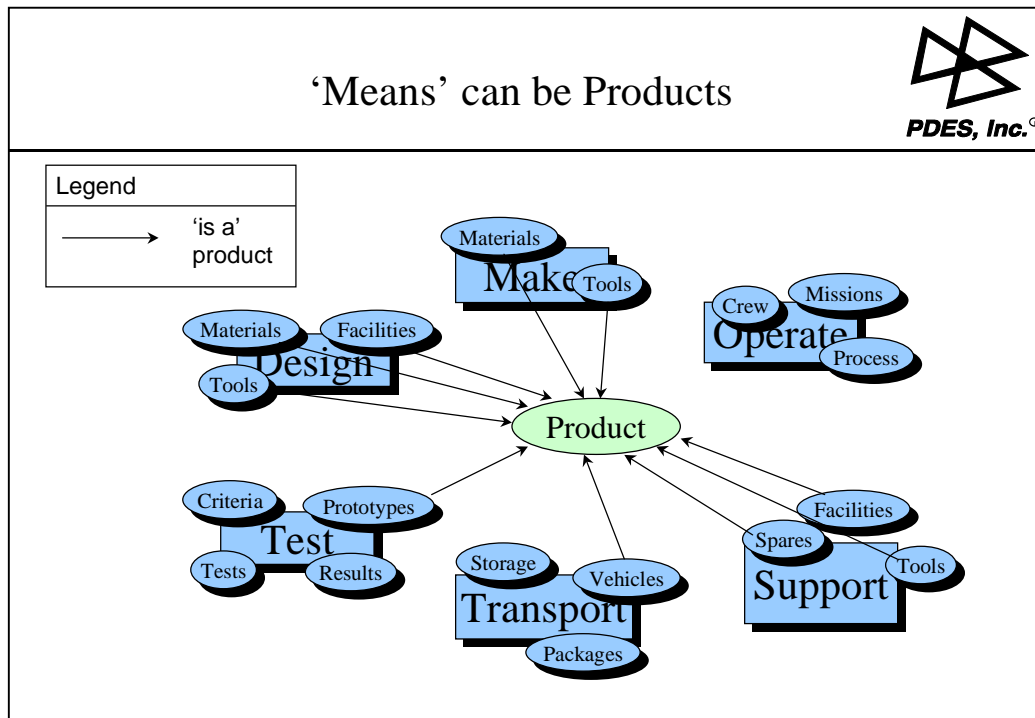
4.1. Presentation and Representation



This picture graphically describes the difference between:

- 'Product Data' that describes the product
- Representations that could also be used to represent things other than product
e.g. geometry can represent the shape of a plane, the path of a space shuttle, or the border of a drawing.
The choice of how product shape is represented is an industry decision; for example, in theory you could represent the shape for manufacture by a finite element model.
- Presentation data which contains no Product information but defines how information should be displayed on paper, screen etc.

4.2. Means and Product



How you describe an object often varies depending upon your particular viewpoint. For instance a block of metal would be

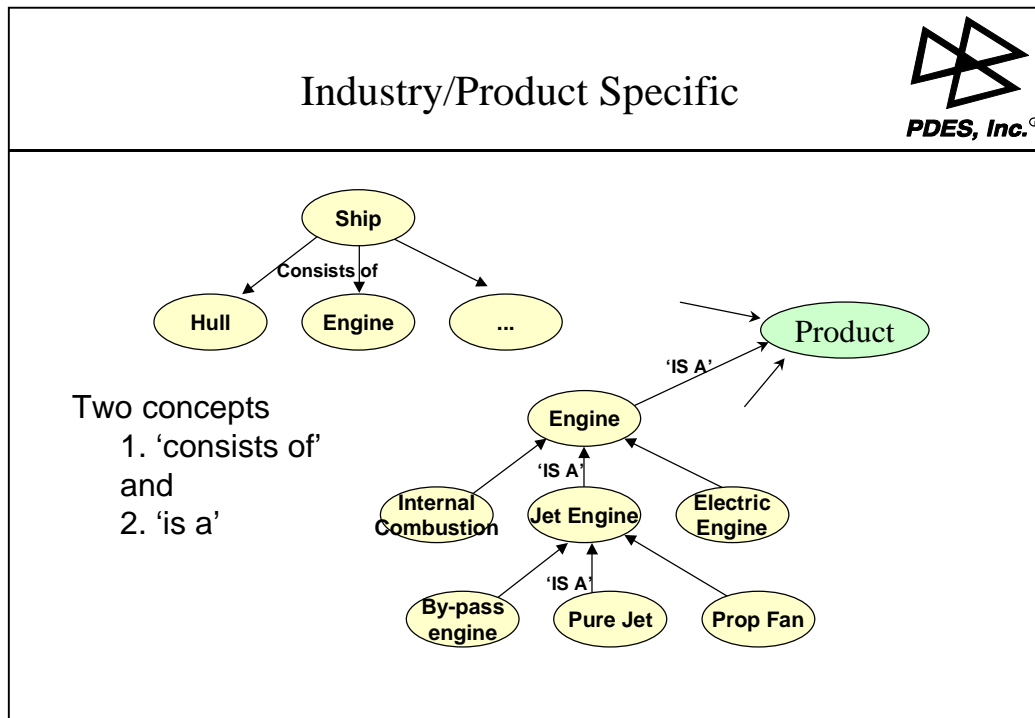
- a product to the company selling it
- material to a company making something else from it

Looking at the Means for the 'Create Product' process we see that the organisations that design, make and operate/support the products are products in their own right. Someone has designed and built them and they are then operated and supported. The organisations consist of many items:

- Facilities
- Materials
- Buildings
- Tools
- Etc.

All of these items are in fact products in their own right and hence have been through their own 'product life-cycle'. This is shown by the 'is a' relationship to Product.

4.3. Industry Concepts to Product

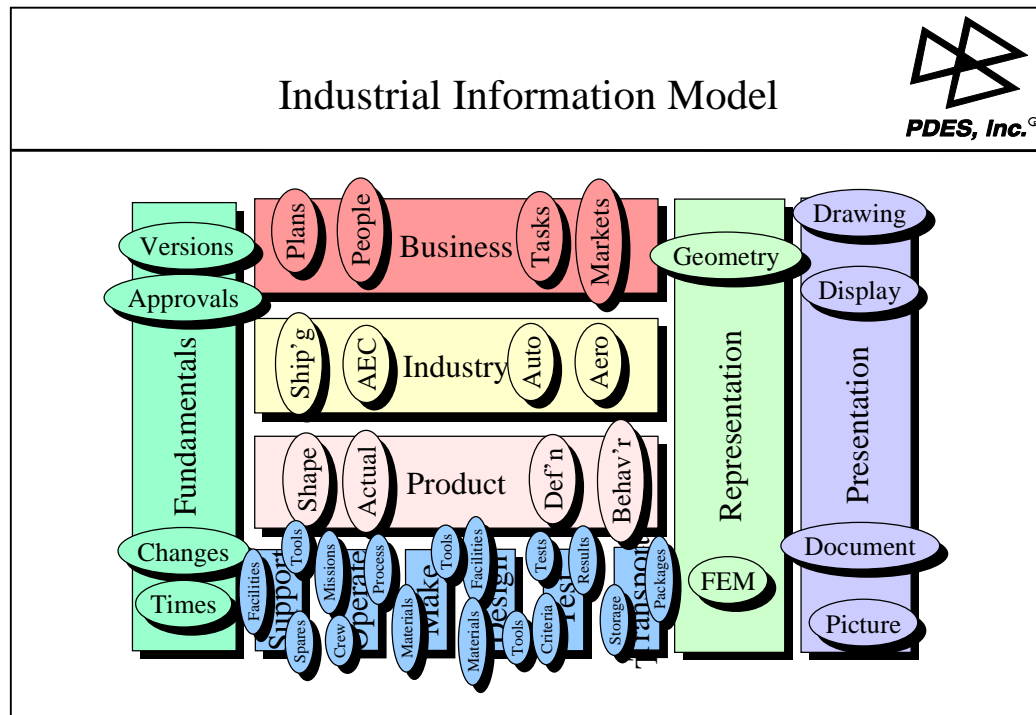


There is a need within specific industries to model and exchange industry or product specific information. While a full survey has not been undertaken as yet, there are two concepts that are modelled.

- Consists of - the specification of what a typical product is composed of
- Is a - the classification of different types of product

Since all of the concepts being modelled are themselves products they have another 'is a' relationship, this time to Product.

5. Mapping Concepts onto the IIM



This picture shows how some lower level concepts map onto this view of Industrial Information. Application Modules that represent these concepts **MUST** be positioned or scoped into this overall structure.

Also there are basic relationships that link the modules together: -

- Some of these will be fundamental truths, for example a product has one or more product_definitions
- Others will be design decisions, for example, product_shape is represented by a geometric model (it could be represented by a drawing, and there are alternative geometric models).
- In general a Product concept will have a Representation which in turn will have a Presentation